

New taxonomic considerations on some species of the genus *Grosphus* Simon, with description of a new species (Scorpiones, Buthidae)¹

Wilson R. LOURENÇO

Laboratoire de Zoologie (Arthropodes), Muséum National d'Histoire Naturelle,
61 rue de Buffon, F-75005 Paris, France. E-mail: arachne@mnhn.fr

New taxonomic considerations on some species of the genus *Grosphus* Simon, with description of a new species (Scorpiones, Buthidae).

Revised redescrptions are proposed for two closely related species of *Grosphus* Simon, namely: *Grosphus limbatus* (Pocock) and *Grosphus bistrifurcatus* Kraepelin. A new species, *Grosphus ankarafantsika* sp. n. also related with these, is described from the Ankarafantsika Reserve in the Province of Majunga, Madagascar. The morphology of the basal middle lamellae of the pectines is illustrated by using scanning electron microscopy. A revised key to the 11 known species of the genus is presented.

Key-words: Scorpions - *Grosphus* - revision - new species - Madagascar - Ankarafantsika Reserve.

INTRODUCTION

As mentioned in recent papers (Lourenço, 1999, 2001), the first *Grosphus* species to be described was *Scorpio (Androctonus) madagascariensis* Gervais (1843) = *Grosphus madagascariensis* (Gervais, 1843). This was followed by another isolated description, of *Buthus limbatus* (= *Grosphus limbatus*), by Pocock (1889). Kraepelin (1900) contributed to the study of the genus *Grosphus* with a more important publication in which several species were described. In his comprehensive monograph on the scorpions of Madagascar, Fage (1929) described a new variety of *Grosphus limbatus*, which he named *annulata*. This variety has meanwhile been raised to specific rank as *Grosphus annulatus* (Lourenço, 1996). Several other taxa new to the fauna of Madagascar were described by Lourenço (1995, 1996). The genus *Grosphus*, however, remained more or less stable in its composition. After the publication of Fage's (1929) monograph only three new species were described (Lourenço, 1996, 1999, 2001).

Even though the original descriptions of *Grosphus* species were in most cases quite clear and have been confirmed in subsequent diagnoses (Fage, 1929; Lourenço, 1996), certain characters may require a re-examination. The taxonomy of *Grosphus* is based mainly on two major characters: the pattern of colouration, and the morphology of the basal middle lamellae of the female pectines. For some closely related species,

¹ This study was supported by the Department of cultural affairs, City of Geneva, Switzerland.

such as *Grosphus limbatus* and *Grosphus bistriatus* recent studies (see Lourenço, 1996) were largely based on old and faded material preserved in alcohol. In this material, the patterns of colouration and pigmentation could no longer be observed precisely. In the present study, redescrptions are given for *Grosphus limbatus* and *Grosphus bistriatus*. These redescrptions are based on newly collected material which allows precise observation of the patterns of pigmentation. In addition, the morphology of the basal middle lamella of the pectines is illustrated using scanning electron microscopy. A new species of *Grosphus*, also related with *G. limbatus* and *G. bistriatus*, is described as well.

TAXONOMIC TREATMENT

REDESCRIPTIONS OF *GROSPHUS LIMBATUS* (POCOCK, 1889) AND *GROSPHUS BISTRATUS* KRAEPELIN, 1900

Grosphus limbatus (Pocock)

Figs 1-2, 9

Buthus limbatus Pocock, 1889: 346.
Grosphus limbatus; Kraepelin, 1891: 72.
Grosphus limbatus; Kraepelin, 1895: 84
Grosphus limbatus; Kraepelin, 1899: 33.
Grosphus limbatus; Fage, 1929: 653.
Grosphus limbatus; Lourenço, 1996: 10.

Material examined: Madagascar, Central region, "Massif de l'Ibity", 40 km south of Antsirabe (2254 m), II/III/2000 (F. Glaw & M. Vences coll.): 6 females, 1 female with brood (34 juveniles), 1 female with brood (72 juveniles); II/2001 (G. Garcia Herrero coll): 2 females (badly preserved).

Coloration. Basically yellow to reddish-yellow. Prosoma: carapace dark yellowish, with an inverted triangular blackish spot stretching from the median eyes to the lateral eyes; a wide blackish central spot behind the median eyes, fusing with the central blackish band over the mesosomal tergites; lateral margins blackish; eyes surrounded by black pigment. Mesosoma: yellowish with a central longitudinal blackish band over tergites I-VII. Metasoma: segments I-IV reddish-yellow; segment V reddish with dark or blackish zones especially on the ventral aspect. All ventral and latero-ventral carinae marked with blackish spots. Vesicle reddish-yellow with some dispersed dark spots; aculeus reddish at its base and blackish at its extremity. Venter: coxapophysis, sternum, genital operculum and pectines yellowish; sternites yellow with some discrete reddish zones; sternite VII with blackish spots over the carinae. Chelicerae yellowish without any variegated pigmentation; teeth of fingers reddish to blackish. Pedipalps: yellowish with only two small blackish spots at the base of the movable fingers; rows of granules on the edges of the fingers dark to blackish. Legs yellowish, without spots.

Morphology. Carapace moderately granular; anterior margin almost straight, with a weak median concavity. All carinae weak; furrows moderate to strong. Median ocular tubercle slightly anterior to the center of carapace; median eyes separated by one ocular diameter. Three pairs of lateral eyes. Sternum between sub-triangular and sub-pentagonal in shape. Mesosoma: tergites with thin, moderately intense granulation.

Median carina moderately developed on all tergites. Tergite VII pentacarinata. Venter: genital operculum consisting of two subtriangular plates. Pectines: pectinal teeth count (24 to 27); basal middle lamellae of each pecten elongated and weakly curved, widening only in proximal third. Sternites smooth, with moderately elongated stigmata; VII with four vestigial carinae and a few thin granules. Metasoma: segments I to III with 10 carinae, moderately crenulate. Segment IV with 8 carinae, moderately crenulate. Segment V with 5 carinae, the dorsal one being only weakly marked. Dorsal carinae on segments I-IV with weak posterior spinoid granules. Intercarinal spaces moderately to weakly granular. Telson with dispersed granules on lateral and ventral surfaces; dorsal surface smooth; aculeus moderately curved and shorter than the vesicle; subaculear tooth absent. Cheliceral dentition characteristic of the family Buthidae; two distinct basal teeth present on the movable finger, the more basal one being slightly reduced (Vachon, 1963); ventral aspect of both fingers and of manus with dense, long setae. Pedipalps: femur pentacarinata; patella with carinae represented by spinoid granules on the internal and dorsal faces; tibia without carinae, all faces weakly granular to smooth. Movable and fixed fingers with 13/12 oblique rows of granules. Trichobothriotaxy; orthobothriotaxy A- α (Vachon, 1974, 1975). Legs: tarsus with numerous very short thin setae ventrally. Patellar spurs present on legs III and IV; pedal spurs present on legs I to IV; all spurs strong.

***Grosphus bistriatus* Kraepelin**

Figs 3-4, 15, 17, 21

Grosphus bistriatus Kraepelin, 1900: 14.

Grosphus bistriatus; Kraepelin, 1901: 267.

Grosphus bistriatus var. *pallicauda* Strand, 1908: 485.

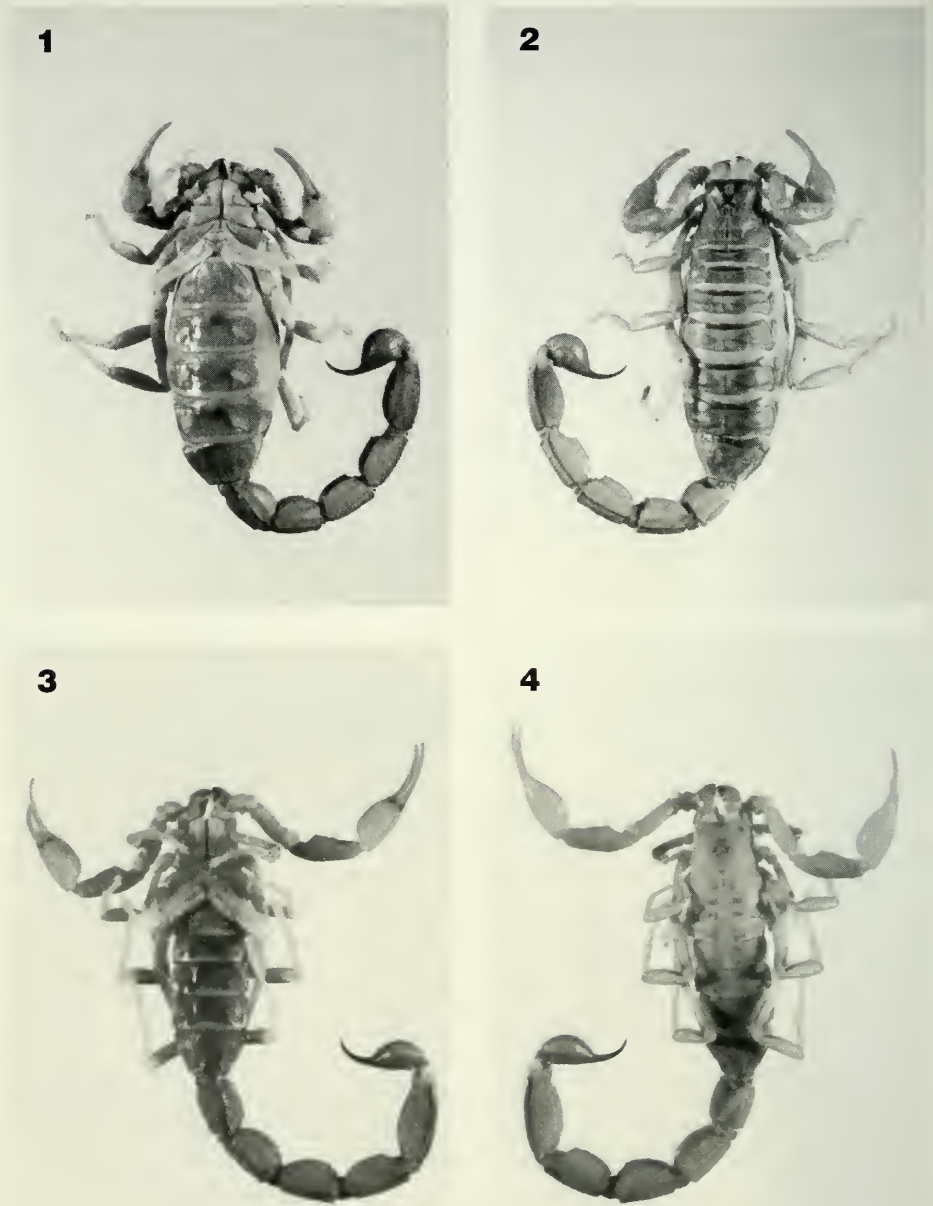
Grosphus bistriatus; Fage, 1929: 651.

Grosphus bistriatus; Lourenço, 1996: 13.

Material examined: Madagascar, Western Region, Ambalanjanakomby, II/2000 (O. Ramilijaona coll.): 1 male. Malainmbandy, VIII/2000 (O. Ramilijaona): 1 female, 1 juvenile (female).

Coloration. Basically yellowish. Prosoma: carapace pale yellow with two longitudinal blackish lines behind the median eyes; one small dark spot on the anterior margin and two on the posterior margin fusing with the longitudinal blackish bands on mesosomal tergites; eyes surrounded by black pigment. Mesosoma: yellowish with two longitudinal blackish bands over tergites I-VI, more densely marked in the posterior half of each tergite. Metasoma: all segments yellow with some dark pigmentation on their ventral aspect, most pronounced on segment V; two diffuse spots present on the dorsal face of segment V. Vesicle yellow with dispersed light brownish spots laterally and ventrally; aculeus reddish yellow. Venter: coxapophysis, sternum, genital operculum and pectines yellowish; sternites yellow. Chelicerae yellowish, without any variegated pigmentation; only a few dark spots at the base of reddish fingers. Pedipalps: yellowish throughout without any pigmentation. Legs yellowish with discrete brownish variegated pigmentation.

Morphology. Carapace intensely granular; anterior margin almost straight with a weak median concavity. All carinae weak to moderately developed; furrows moderately developed. Median ocular tubercle anterior to the center of carapace; median eyes separated by a little more than one ocular diameter. Three pairs of lateral



FIGS 1-4

1-2. *Grosphus limbatus*, female, ventral and dorsal aspects (photos Cl. Ratton). 3-4. *Grosphus bistriatus*, male, ventral and dorsal aspects (photos Cl. Ratton).

eyes. Sternum between sub-triangular and sub-pentagonal in shape. Mesosoma: tergites with a thin and intense granulation. Median carina moderate on all tergites. Tergite VII pentacarinata. Venter: genital operculum consisting of two subtriangular plates. Pectines: pectinal teeth count (28 in males; 25-26 in females); basal middle lamellae of each pecten not dilated in males, elongated and weakly curved in females, widening in proximal half. Sternites smooth, with moderately elongated stigmata; VII with four vestigial carinae and a few thin granules. Metasoma: segments I and II with 10 carinae, moderately crenulate. Segments III and IV with 8 carinae, moderately crenulate. Segment V with 5 carinae, the dorsal ones being only weakly marked. Dorsal carinae on segments I-IV without any posterior spinoid granules. Intercarinal spaces moderately granular. Telson with very few granules on lateral and ventral surfaces; dorsal surface smooth; aculeus moderately curved and shorter than the vesicle; subaculear tooth absent. Cheliceral dentition characteristic of the family Buthidae (Vachon, 1963); two distinct basal teeth present on the movable finger, the more basal one being slightly reduced; ventral aspect of both fingers and of manus with dense, long setae. Pedipalps: femur pentacarinata; patella with carinae represented by some spinoid granules on the internal face; tibia without carinae, all faces weakly granular to smooth. Movable and fixed fingers with 12/11 oblique rows of granules. Trichobothriotaxy; orthobothriotaxy A- α (Vachon, 1974, 1975). Legs: tarsus with numerous short thin setae ventrally. Patellar spurs present on legs III and IV, pedal spurs present on legs I to IV; all spurs strong.

DESCRIPTION OF A NEW SPECIES

Grosphus ankarafantsika sp. n.

Figs 5-8, 10-14, 16, 18-20, 22-25

Grosphus bistriatus; Fage, 1929: 651-652 (in part, misidentification)

Grosphus bistriatus; Lourenço, 1996: 13 (misidentification)

Grosphus bistriatus; Lourenço, 2001: 459 (misidentification)

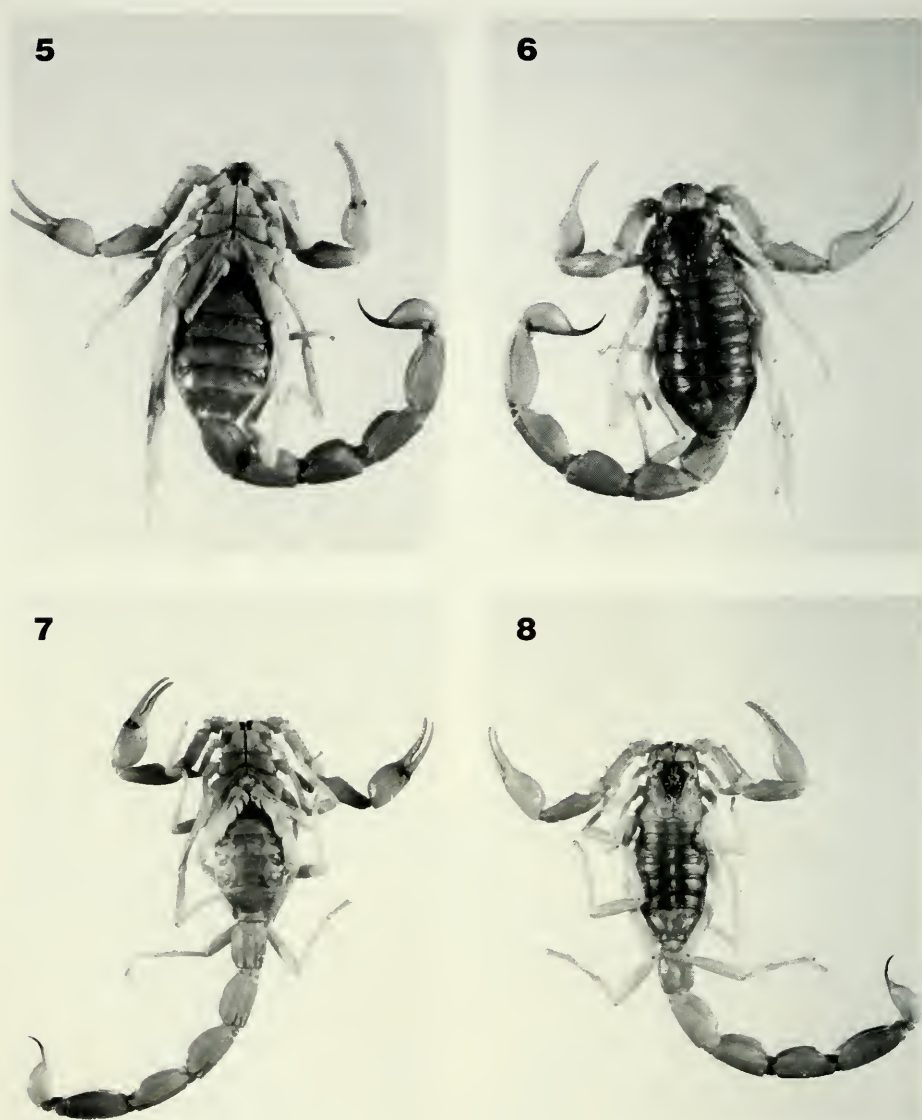
Material examined: Madagascar, Majunga Province, Ankarafantsika Reserve, Ampijoroa Forest Station (16°18'S 46°48'E), sand area of *Paquyopodium* (G. García Herrero coll.), 27/II, 01/III/2001 (pitfall traps): 1 female (holotype), 11 males (paratypes); "Jardin Botanique A" (G. Garcia Herrero coll.), 24-27/II/2001 (pitfall traps): 6 males, 2 females, 1 female with brood (45 juveniles) (paratypes). Type material deposited in the Muséum d'histoire naturelle, Genève.

Etymology: The name of the type locality (Ankarafantsika Reserve) is placed in apposition to the generic name.

Diagnosis: The morphology of the new species shows that it is close to *Grosphus bistriatus* Kraepelin, but it can be readily distinguished from that species by the following characters: (i) carapace yellowish with an inverted triangular blackish spot; (ii) dark confluent zones on lateral sides of tergites, next to the blackish bands; (iii) spots on legs vestigial or absent; (iv) carapace moderately granular; (v) basal middle lamellae of the female pectines elongated and curved, constantly narrowing from the base to the apex.

Description: It is based on female holotype and one male paratype. Measurements in Table I.

Coloration. Basically yellowish with some dark zones on the body. Prosoma: carapace yellow with an inverted blackish triangular spot between median and lateral



FIGS 5-8

Grosphus ankarafantsika sp. n. 5-6. Female holotype. 7-8. Male paratype. Ventral and dorsal aspects (photos Cl. Ratton).

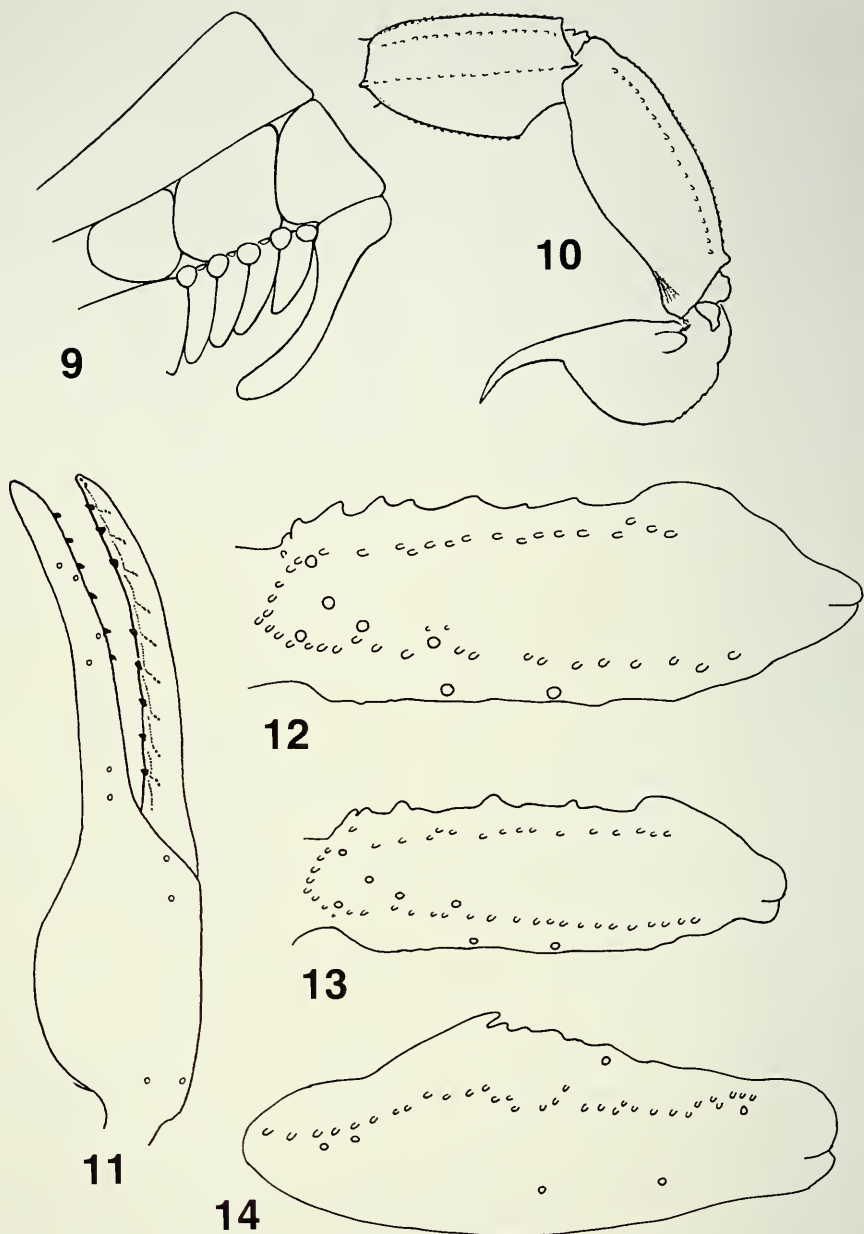
eyes; two dark spots on the posterior margin: eyes surrounded by black pigment. Mesosoma: dark yellow with confluent dark zones and with two longitudinal blackish strips over tergites I-VI running from the two spots on the posterior margin of the carapace. Metasoma: all segments yellowish with some vestigial dark pigmentation on the ventral carinae. Vesicle reddish yellow without spots; aculeus with yellowish base and dark reddish tip. Venter: coxapophysis, sternum, genital operculum and pectines

TABLE I. Morphometric values (in mm) of the male paratype and female holotype of *Grosphus ankarafantsika* sp. n.

	♂-paratype	♀-holotype
Total length	37.0	49.0
Carapace:		
- length	4.6	6.0
- anterior width	3.3	4.6
- posterior width	4.8	7.5
Metasomal segment I:		
- length	3.3	4.4
- width	2.8	3.9
Metasomal segment V:		
- length	5.7	7.3
- width	3.0	3.8
- depth	2.3	3.3
Vesicle:		
- width	2.3	3.0
- depth	1.9	2.8
Pedipalp:		
- Femur length	3.5	5.2
- Femur width	1.2	1.6
- Patella length	5.0	6.0
- Patella width	1.8	2.4
- Tibia length	8.4	10.2
- Tibia width	2.3	2.7
- Tibia depth	2.2	2.6
Movable finger:		
- length	4.6	6.2

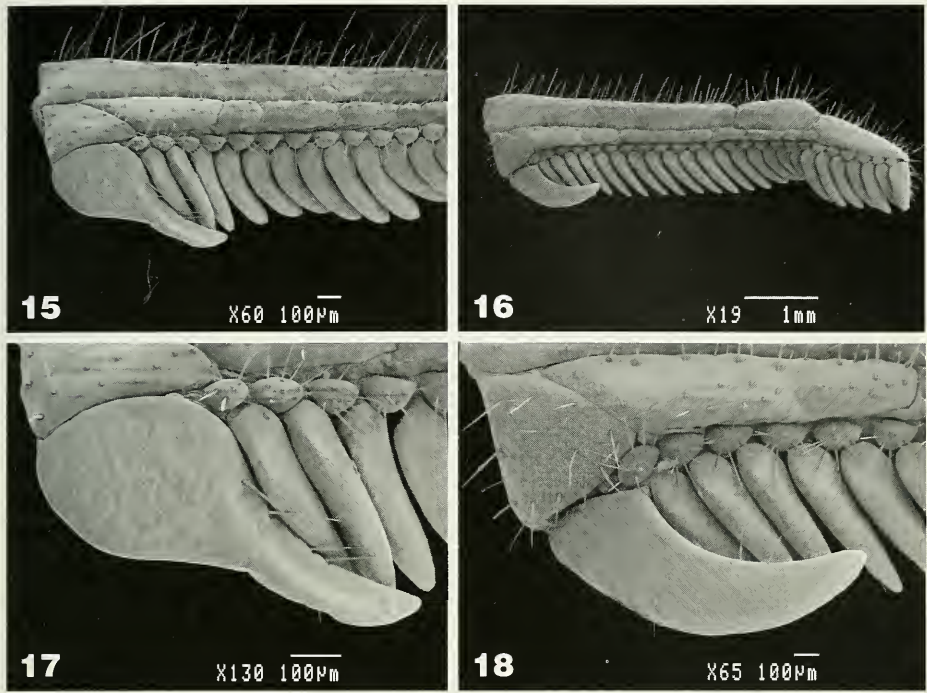
yellowish; sternites reddish yellow. Chelicerae yellowish with dark variegated pigmentation on the anterior third; fingers reddish. Pedipalps: yellowish with vestigial dark zones on femur and patella. Legs yellowish with vestigial brownish zones (absent in some specimens).

Morphology. Carapace moderately granular; anterior margin almost straight, with a weak median concavity. All carinae weak; furrows moderately developed. Median ocular tubercle anterior to the center of carapace; median eyes separated by a little more than one ocular diameter. Three pairs of lateral eyes. Sternum between subtriangular and sub-pentagonal in shape. Mesosoma: tergites with thin but moderately intense granulation. Median carina moderately developed in all tergites. Tergite VII pentacarinata. Venter: genital operculum consisting of two subtriangular plates. Pectines: pectinal teeth count 24-24 (female holotype; variation: 27 to 31 in males; 24 to 27 in females); basal middle lamellae of each pecten not dilated in males; elongated and curved in females; constantly narrowing from the base to the apex. Sternites smooth, with elongated stigmata; VII with two vestigial carinae. Metasoma: segments I and II with 10 carinae, moderately crenulate. Segments III and IV with 8 carinae, moderately crenulate. Segment V with 5 carinae, the dorsal one being only weakly pronounced. Dorsal carinae on segments I-IV without any posterior spinoid granules. Intercarinal spaces weakly granular. Telson with granules scattered over latero-ventral



FIGS 9-14

9. *Grosphus limbatus*. Detail of basal middle lamellae of the female pecten. 10-14. *Grosphus ankarafantsika* sp. n. 10. Metasomal segments IV-V and telson, lateral aspect (female holotype). 11-14. Trichobothrial pattern. 11. Tibia (female holotype). 13. Femur (male paratype). 14. Patella (male paratype).



FIGS 15-18

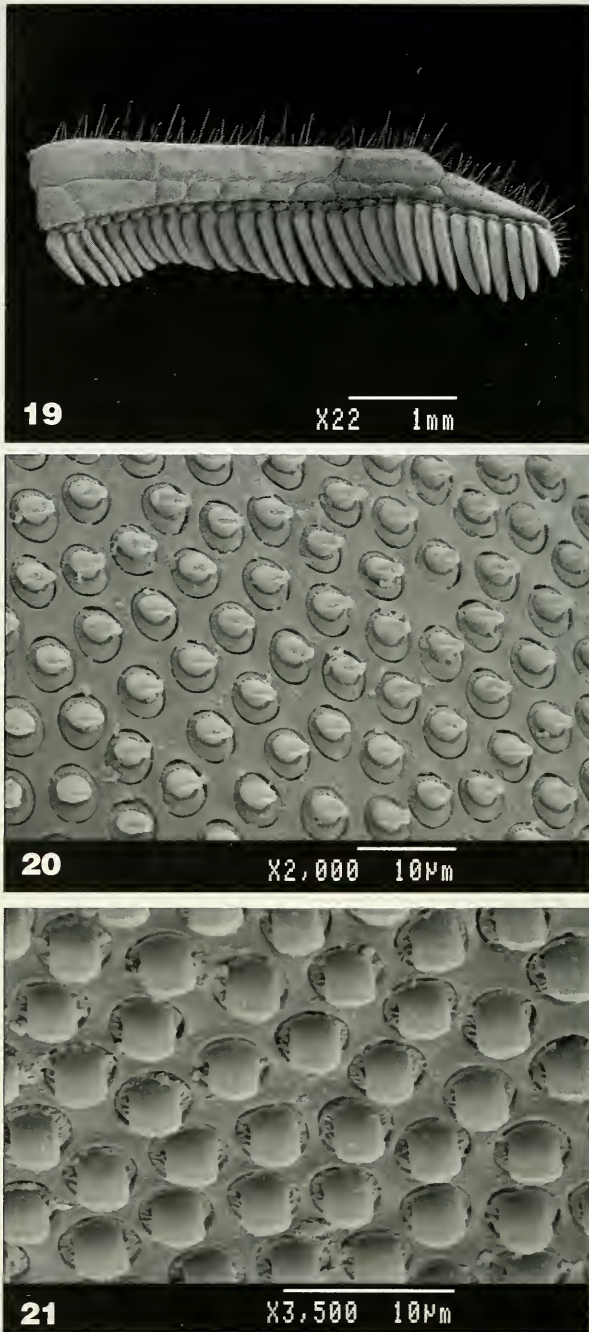
15,17. *Grosphus bistriatus*. 16,18. *Grosphus ankarafantsika* sp. n. 15-16. Left pecten of female. 17-18. Basal middle lamellae, in detail.

and ventral surfaces; its dorsal surface smooth; aculeus moderately curved and shorter than the vesicle; subaculear tooth absent. Cheliceral dentition characteristic of the family Buthidae (Vachon, 1963); two distinct basal teeth present on the movable finger, the more basal of them being slightly reduced; ventral aspect of both fingers and of manus with dense, long setae. Pedipalps: femur pentacarinata; patella with a dorso-internal carina and with several spinoid granules on the internal face; tibia smooth, without carinae, all faces weakly granular to smooth. Movable and fixed fingers with 11/10 (females) and 12/11 (males) oblique rows of granules. Trichobothriotaxy; orthobothriotaxy A- α (Vachon, 1974, 1975). Legs: tarsus with numerous short thin setae ventrally. Patellar spurs present on legs III and IV; pedal spurs present on legs I to IV; all spurs strong.

Remarks: The new species was collected in the Reserve together with *Grosphus madagascariensis* (Gervais) and *Grosphus garciai* Lourenço. These specimens are also deposited in the Muséum d'histoire naturelle, Genève.

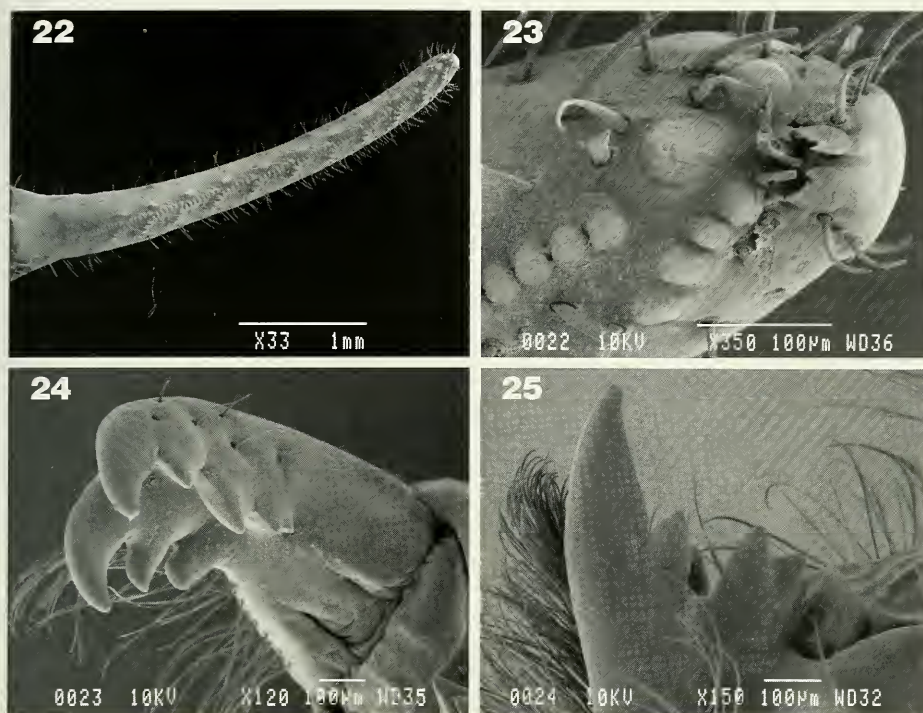
DISCUSSION

Buthus limbatus (= *Grosphus limbatus*) was described by Pocock (1889) on the basis of four specimens (one male and three females) collected by Rev. R. Baron in



FIGS 19-21

Pectines. 19. Male pecten of *Grosphus ankarafantsika* sp. n., global view. 20-21. Microstructure of peg sensilla on teeth. 20. *Grosphus ankarafantsika* sp. n. 21. *Grosphus bistriatus*.



FIGS 22-25

Grosphus ankarafantsika sp. n. (male paratype). 22. Movable finger of tibia pedipalp. 23. Detail of distal extremity of the same. 24. Movable finger of chelicera. 25. Fixed finger of chelicera.

Madagascar, but without giving any precise locality. The description by Pocock was very precise, and Fage (1929) was subsequently able to identify further material of this species (probably without examination of Pocock's type material) and to demonstrate its presence on the Central Plateau of Madagascar.

The morphology of the basal middle lamellae of the female pectines is a diagnostic character for *Grosphus* species. The description given by Pocock (1889) for this character is clear and accurate: "in the female the basal tooth is very much enlarged being about twice as long as the rest and flask-shaped, i. e. dilated proximally and abruptly narrowed and slender distally." This character was precisely illustrated by Pocock (1889: Fig. 7a), and also by Fage (1929: Fig. 6); its morphology was later confirmed by Lourenço (1996: Fig. 8).

The precise identity of *Grosphus bistriatus* appears unclear. This species was described by Kraepelin (1900), on the basis of two specimens (syntypes) collected near Tulear in the south of Madagascar. Fage (1929), based his redescription on several specimens from different localities, including some from the "Massif d'Ambre" and "Maevatanana" in the northern range of the island. One of the syntypes, preserved in alcohol and deposited in the "Muséum national d'Histoire naturelle" in Paris, was

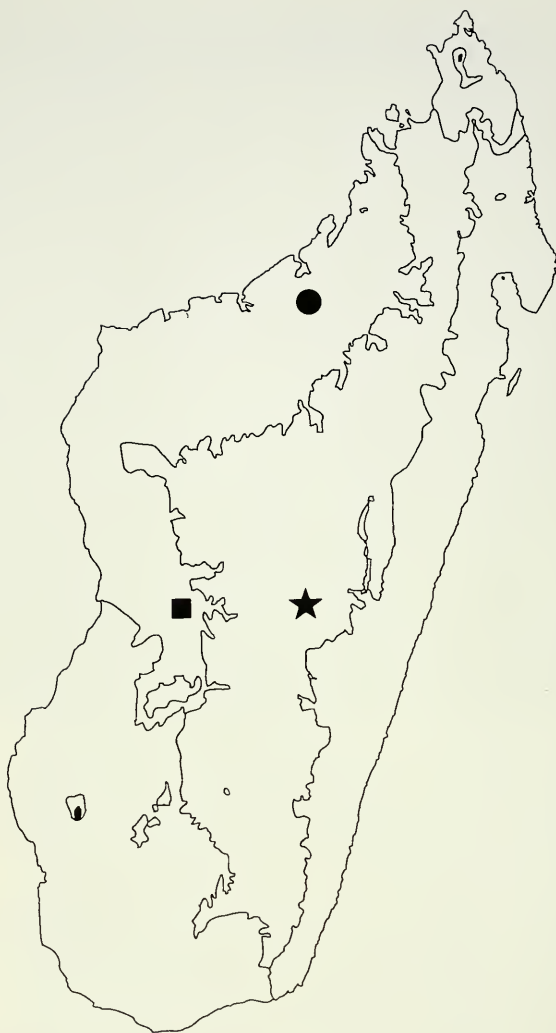


FIG. 26

Map showing the type locality of *Grosphus ankarafantsika* sp. n. (black circle) and the sites from where the new material of *G. limbatus* (black star) and *G. bistriatus* (black square) has been collected.

probably already bleached when Fage examined it. Therefore, the colouration described by Fage was probably based on other non-type specimens. The morphology of the basal middle lamellae of the female pectines, illustrated by Fage (1929: Fig. 5), differs from that of the bleached syntype. In his diagnosis of *G. bistriatus*, Lourenço (1996) accepted the redescription by Fage (1929) and reported the presence of this species in the "Réserve naturelle intégrale n° 7 de l'Ankarafantsika); a misidentification subsequently confirmed by Lourenço (2001).

An examination of newly collected material of *G. bistriatus* from close to the type locality (region of Tulear), provide clarification on coloration and patterns of pigmentation of this species. In addition, the precise morphology of the basal middle lamellae of female pectines is described in here. Moreover, the population present in the Ankarafantsika Reserve is described as a new species, i. e. *G. ankarafantsika* sp. n. *Grosphus limbatus*, *G. bistriatus*, *G. intertidalis* Lourenço and *Grosphus ankarafantsika* sp. n. represent a species group which is isolated from the other species of the genus.

KEY TO THE SPECIES OF THE GENUS *GROSPHUS*

- | | | |
|-----|---|----------------------------|
| 1 | Pectines with a maximum of 21 teeth | 2 |
| (1) | Pectines with more than 22 teeth | 4 |
| 2 | Colouration yellowish to reddish yellow, with variegated brownish pigmentation; body length about 30 mm | <i>G. garciai</i> |
| (2) | Colouration dark, from reddish brown to dark brown; body length about 50 mm | 3 |
| 3 | Colouration reddish brown to dark brown, without light spots; metasomal segment I longer than wide; basal middle lamellae of female pectines oval in shape | <i>G. madagascariensis</i> |
| (3) | Colouration reddish brown with lighter spots; metasomal segment I wider than long; basal middle lamellae of female pectines subquadrangular in shape | <i>G. hirtus</i> |
| 4 | Colouration blackish throughout; pectines with 30 to 40 teeth; body length more than 90 mm | <i>G. grandidieri</i> |
| (4) | Colouration reddish brown to yellowish, never blackish; body length less than 90 mm | 5 |
| 5 | Mesosoma with homogenous colouration, reddish brown or yellowish | 6 |
| (5) | Mesosoma with a blackish median longitudinal band, or with two blackish lateral longitudinal bands | 9 |
| 6 | Total length more than 70 mm; mesosoma reddish brown; basal middle lamellae of female pectines two times longer than wide at their base | <i>G. flavopiceus</i> |
| (6) | Total length less than 60 mm; mesosoma yellowish; basal middle lamellae of female pectines three times longer than wide at the base | 7 |
| 7 | Metasomal segment V and telson pale yellowish | <i>G. intertidalis</i> |
| (7) | Metasomal segment V and telson with blackish spots or blackish throughout | 8 |
| 8 | Metasomal segment V and telson with blackish spots | <i>G. annulatus</i> |
| (8) | Metasomal segment V and telson blackish | <i>G. feti</i> |
| 9 | Mesosoma with a wide blackish median longitudinal band; basal middle lamellae of female pectines three times longer than wide at their base and covering the 4 proximal teeth | <i>G. limbatus</i> |
| (9) | Mesosoma with two narrow blackish lateral longitudinal bands | 10 |

- 10 Carapace without a blackish triangular spot; basal middle lamellae of female pectines weakly curved, widening in proximal half and covering the two proximal teeth *G. bistriatus*
- (10) Carapace with a blackish triangular spot; basal middle lamellae of the female pectines curved and constantly narrowing from the base to apex covering the four proximal teeth *G. ankarafansika* sp. n.

ACKNOWLEDGEMENTS

I am very grateful to R. Cleva and L. Albenga (Muséum national d'Histoire naturelle, Paris), for technical help with the preparation of SEM photos. To Prof. John L. Cloudsley-Thompson, London, and to Dr Peter Schwendinger, Muséum d'histoire naturelle, Geneva for reviewing the manuscript.

REFERENCES

- FAGE, L. 1929. Les Scorpions de Madagascar. Faune des Colonies françaises 3. *Société d'Éditions Géographiques, Maritimes et Coloniales, Paris*, pp. 637-694.
- GERVAIS, P. 1844. Remarques sur la famille des Scorpions. *Archives du Muséum d'Histoire Naturelle, Paris* 4: 201-240.
- KRAEPELIN, K. 1891. Revision der Skorpione. I. Die Familie der Androctonidae. *Jahrbuch der Hamburgischen wissenschaftlichen Anstalten* 8: 1-144.
- KRAEPELIN, K. 1895. Nachtrag zu Theil I der Revision der Skorpione. *Jahrbuch der Hamburgischen wissenschaftlichen Anstalten* 12: 73-96.
- KRAEPELIN, K. 1899. Scorpiones und Pedipalpi. In: F. DAHL (ed.). Das Tierreich. Herausgegeben von der Deutschen zoologischen Gesellschaft. 8 (Arachnoidea). *R. Friedländer und Sohn Verlag, Berlin*, 265pp.
- KRAEPELIN, K. 1900. Ueber einige neue Gliederspinnen. *Abhandlungen aus dem Gebiete der Naturwissenschaften* 16: 3-17.
- KRAEPELIN, K. 1901. Catalogue des scorpions des collections du Muséum d'histoire naturelle de Paris. *Bulletin du Muséum national d'histoire naturelle, Paris* 7: 263-265.
- LOURENÇO, W. R. 1995. Description de trois nouveaux genres et quatre nouvelles espèces de Scorpions Buthidae de Madagascar. *Bulletin du Muséum National d'Histoire Naturelle, Paris*, 4e sér. 17 (1-2): 95-106.
- LOURENÇO, W. R. 1996. Scorpions (Chelicerata, Scorpiones). In: Faune de Madagascar N° 87. *Muséum National d'Histoire Naturelle, Paris*, 102 pp.
- LOURENÇO, W. R. 1999. A new species of *Grosphus* Simon (Scorpiones, Buthidae), the first record of an intertidal scorpion from Madagascar. *Entomologische Mitteilungen aus dem Zoologischen Museum Hamburg* 12 (158): 297-307.
- LOURENÇO, W. R. 2001. Another new species of *Grosphus* (Scorpiones, Buthidae) for Madagascar. *Revue suisse de Zoologie* 108 (3): 455-461.
- POCOCK, R. I. 1889. Notes on some Buthidae, new and old. *Annals and Magazine of Natural History*, ser. 6, 3: 334-351.
- STRAND, E. 1908. Arachniden aus Madagaskar, gesammelt von Herrn Walter Kaudern. *Zoologische Jahrbücher, Abtheilung für Systematik* 26: 453-488.
- VACHON, M. 1963. De l'utilité, en systématique, d'une nomenclature des dents des chélicères chez les Scorpions. *Bulletin du Muséum National d'Histoire Naturelle, Paris*, 2è sér. 35 (2): 161-166.
- VACHON, M. 1974. Etude des caractères utilisés pour classer les familles et les genres de Scorpions (Arachnides). 1. La trichobothriotaxie en arachnologie. Sigles trichobothriaux et types de trichobothriotaxie chez les Scorpions. *Bulletin du Muséum National d'Histoire Naturelle, Paris*, 3è sér., n° 140, Zool. 104: 857-958.
- VACHON, M. 1975. Sur l'utilisation de la trichobothriotaxie du bras des pédipalpes des Scorpions (Arachnides) dans le classement des genres de la famille des Buthidae Simon. *Comptes Rendus de l'Académie des Sciences, Paris*, sér. D. 281: 1597-1599.